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London Rd
St Ives
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part no. 48584 430

sinclair

Sinclair Cambridge Programmable

Works out mortgage repayments
Solves quadratic equations
Calculates linear regression
Helps design a twin-T filter
Plays a lunar landing game!

USERS LIBRARY

We've written programs in the Sinclair Program Library to cover a very wide variety of subjects but we'd very much like to hear about any other interesting programs you've written for your Sinclair Cambridge Programmable. By sending in your own program you will become a member of the Sinclair Programmable Users' Library: we'll keep you in touch with news on the other programs in the Users' Library so you can get even better use of your Sinclair Cambridge Programmable.

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To solve hundreds of problems in finance, mathematics, statistics, physics, engineering and electronics, we've written 294 programs specially for the Sinclair Cambridge Programmable. There are 12 samples in this booklet – the rest are all in the Sinclair Program Library.

Before you try any of the programs, familiarise yourself with the calculator by working, calculator in hand, through the Instruction Booklet enclosed. You'll then be able to use the programs quickly and easily.

Remember these are only sample programs reproduced half size – the full Sinclair Program Library is available from Sinclair Radionics Limited, London Road, St Ives, Huntingdon, Cambridgeshire PE17 4HJ, for £1.95 per volume, or £4.95 for all four volumes.

Whatever your speciality, the program library will make the Sinclair Cambridge Programmable the specialist calculator for you!

Day of the week of Christmas Day (program on facing page)

Entering the program

Press	Display
[▲▼] [▲▼] [2] [0] [0] (go to)	0.0000 00
[▲▼] [RUN] (learn)	0.0000 00

Now press the sequence of keys in the program as shown in the first column on the facing page.

Press	Display
[X]	0.0000 01
ChN/# [3]	0.0000 02
[1]	0.0000 03
[•/EE/–]	0.0000 04
.	.
.	.
.	.
.	.
[=]	0.0000 34
stop [0]	0.0000 35
[=]	.0000 00

The last step has brought you back to step 00 which shows the check symbol for X (the first step) i.e. . on the left of the display.

As you are already at step 00 there is no need to press

[▲▼] [▲▼] [2] [0] [0] (go to)

but you need to do this if you finish at any other step number.

DAY OF THE WEEK OF CHRISTMAS DAY (1900 — 2099)

Execution:

year (in full) / RUN / day as a number

where 1 = Sunday
2 = Monday, etc

X	·	00
#	3	01
1	1	02
·	A	03
2	2	04
4	4	05
9	9	06
6	6	07
–	F	08
#	3	09
2	2	10
6	6	11
3	3	12
1	1	13
+	E	14
#	3	15
7	7	16
+	E	17
▼	A	18
gin	1	19
1	1	20
5	5	21
(	6	22
–	F	23
+	E	24
#	3	25
1	1	26
=	–	27
▼	A	28
gin	1	29
2	2	30
4	4	31
)	6	32
=	–	33
stop	0	34
=	–	35

Checking the program

Press	Display
	.0000 00
[▲▼] [C/CE] step	3.0000 01
[▲▼] [C/CE] step	1.0000 02
[▲▼] [C/CE] step	A.0000 03
.	.
.	.
.	.
[▲▼] [C/CE] step	0.0000 34
[▲▼] [C/CE] step	-.0000 35

At each step, the check symbol on the left of the display should correspond with the check symbols shown in the second column on the program.

If you entered the program correctly, press

[▲▼] [▲▼] [2] [0] [0]
go to

then [C/CE] and you are ready to execute the program.

If you made an error at any stage in the program, read the section on correcting the program on page 19 of the instruction booklet.

Executing the program

Example

Press	Display
[1] [9] [7] [7]	1977
[RUN]	1

i.e. Christmas Day in 1977 falls on a Sunday.

BALANCE OUTSTANDING ON A MORTGAGE

Given:
Amount of original mortgage
Monthly repayment
Number of years since mortgage was originally taken out
Rate of interest

Finds:
Balance

Execution:
rate / RUN / number of years / RUN / monthly repayment / RUN / original amount / RUN / balance

Example:
I bought a house seven years ago and took out a mortgage for £5500 at 11½% interest. My monthly repayment has been £70. I now want to sell my house and pay off the mortgage. How much will I have to pay?

Rate	[1] [1] [·] [5] [RUN]
Number of years	[7] [RUN]
Monthly payment	[7] [0] [RUN]
Original amount	[5] [5] [0] [0] [RUN]

Balance = £3438

÷	G	00
#	3	01
1	1	02
0	0	03
.0	0	04
=	–	05
sto	2	06
+	E	07
#	3	08
1	1	09
=	–	10
ln	4	11
X	·	12
stop	0	13
=	–	14
▼	A	15
e^x	4	16
X	·	17
(	6	18
stop	0	19
X	·	20
#	3	21
1	1	22
2	2	23
÷	G	24
rcl	5	25
=	–	26
sto	2	27
–	F	28
+	E	29
stop	0	30
)	6	31
+	E	32
rcl	5	33
=	–	34
stop	0	35

CONVERSIONS

Metres to feet and inches

Execution:

metres / RUN / feet / RUN / inches

Note: This program may take some time to execute.

÷	G	00
#	3	01
·	A	02
3	3	03
0	0	04
4	4	05
8	8	06
–	F	07
(	6	08
–	F	09
#	3	10
1	1	11
=	–	12
▼	A	13
gin	1	14
2	2	15
1	1	16
▼	A	17
goto	2	18
0	0	19
9	9	20
+	E	21
#	3	22
1	1	23
=	–	24
sto	2	25
)	6	26
=	–	27
stop	0	28
rcl	5	29
X	·	30
#	3	31
1	1	32
2	2	33
=	–	34
stop	0	35

PERCENTAGE POINTS OF THE NORMAL DISTRIBUTION

Given any α with $0 < \alpha < 0{\cdot}5$, finds x to within about 2 sig. fig. so that the probability that a standard normal random variable exceeds x is α.

Execution:

α / RUN / x

For greater accuracy (·1% error) divide result by 1·006.

For still greater accuracy use execution sequence

α / X / 1·0007 / RUN / ÷ / 1·006 / = / x

X	·	00
÷	G	01
=	–	02
ln	4	03
$\sqrt{x}$	1	04
sto	2	05
+	E	06
+	E	07
+	E	08
#	3	09
1	1	10
2	2	11
·	A	12
5	5	13
÷	G	14
(	6	15
rcl	5	16
+	E	17
#	3	18
7	7	19
X	·	20
rcl	5	21
+	E	22
#	3	23
5	5	24
=	–	25
)	6	26
–	F	27
+	E	28
rcl	5	29
=	–	30
stop	0	31
▼	A	32
goto	2	33
0	0	34
0	0	35

HYPERBOLIC FUNCTIONS

All the hyperbolic functions

▼	A	00
e^x	4	01
+	E	02
#	3	03
1	1	04
÷	G	05
+	E	06
–	F	07
#	3	08
1	1	09
–	F	10
=	–	11
▼	A	12
arctan	9	13
+	E	14
=	–	15
sto	2	16
tan	9	17
stop	0	18
÷	G	19
=	–	20
stop	0	21
rcl	5	22
cos	8	23
÷	G	24
=	–	25
stop	0	26
÷	G	27
=	–	28
stop	0	29
rcl	5	30
sin	7	31
stop	0	32
÷	G	33
=	–	34
stop	0	35

Execution:

x / RUN / sinh x / RUN / cosech x / RUN / cosh x / RUN / sech x / RUN / tanh x / RUN / coth x /

Range:

$1{\cdot}0017 \times 10^{-4} \leqslant |x| \leqslant 7{\cdot}8566$

QUADRATIC EQUATIONS

$ax^2 + bx + c = 0$

Roots x_1, x_2 if real

R ± iI if complex

Execution:

a / RUN / b / RUN / c / RUN /
- x_1 / RUN / x_2 / RUN / RUN / C/CE / C/CE / if roots are real
- I* / C/CE / RUN / R / if roots are complex

* error symbol displayed

After the sequence a / RUN / b / RUN / c / RUN / the display shows *either* (if the roots are real) the larger real root with no error indication *or* (if the roots are complex) the imaginary part and the error symbol. Continue with the appropriate execution sequence.

The error symbol will tell you whether the roots are complex. The sequence / RUN / RUN / C/CE / shown above after (x_2) is necessary before entering a new equation to be solved.

+	E	00
÷	G	01
–	F	02
X	·	03
sto	2	04
stop	0	05
=	–	06
▼	A	07
MEx	5	08
X	·	09
stop	0	10
+	E	11
+	E	12
(	6	13
rcl	5	14
X	·	15
)	6	16
+	E	17
▼	A	18
gin	1	19
3	3	20
2	2	21
$\sqrt{x}$	1	22
▼	A	23
MEx	5	24
–	F	25
stop	0	26
rcl	5	27
÷	F	28
rcl	5	29
=	–	30
stop	0	31
$\sqrt{x}$	1	32
stop	0	33
rcl	5	34
stop	0	35

CIRCLES

Circumference and area

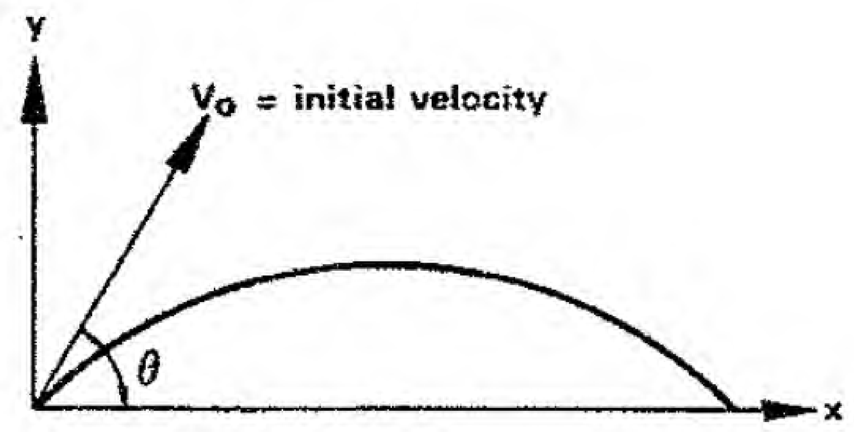
X	·	00
(	6	01
X	·	02
#	3	03
6	6	04
·	A	05
2	2	06
8	8	07
3	3	08
1	1	09
9	9	10
=	—	11
stop	0	12
)	6	13
÷	G	14
#	3	15
2	2	16
=	—	17
stop	0	18
▼	A	19
goto	2	20
0	0	21
0	0	22
		23
		24
		25
		26
		27
		28
		29
		30
		31
		32
		33
		34
		35

Execution:

radius / RUN / circumference / RUN / area

PROJECTILES

Position relative to point of projection after time t



$$x = v_o t \cos\theta$$

$$y = v_o t \sin\theta - \frac{gt^2}{2}$$

Execution:

θ° / RUN / v_o / RUN / t / RUN / x / RUN / y

In S.I. units; g taken as $9{\cdot}81 ms^{-2}$.

▼	A	00
D→R	3	01
sto	2	02
tan	9	03
X	·	04
(	6	05
rcl	5	06
cos	8	07
X	·	08
stop	0	09
X	·	10
stop	0	11
sto	2	12
)	6	13
stop	0	14
—	F	15
(	6	16
rcl	5	17
X	·	18
X	·	19
#	3	20
4	4	21
·	A	22
9	9	23
0	0	24
5	5	25
=	—	26
)	6	27
=	—	28
stop	0	29
▼	A	30
goto	2	31
0	0	32
0	0	33
		34
		35

RELATIVITY

Fitzgerald contraction, time dilation and mass change.

÷	G	00
stop	0	01
X	·	02
–	F	03
+	E	04
#	3	05
1	1	06
=	–	07
$\sqrt{x}$	1	08
sto	2	09
stop	0	10
rcl	5	11
=	–	12
stop	0	13
▼	A	14
goto	2	15
0	0	16
0	0	17
		18
		19
		20
		21
		22
		23
		24
		25
		26
		27
		28
		29
		30
		31
		32
		33
		34
		35

$$T' = T\left(1 - \frac{v^2}{c^2}\right)^{½}$$

$$L' = L\left(1 - \frac{v^2}{c^2}\right)^{½}$$

$$M' = M\left(1 - \frac{v^2}{c^2}\right)^{-½}$$

Execution:

(i) v / RUN / c / RUN / T / X / RUN / T′

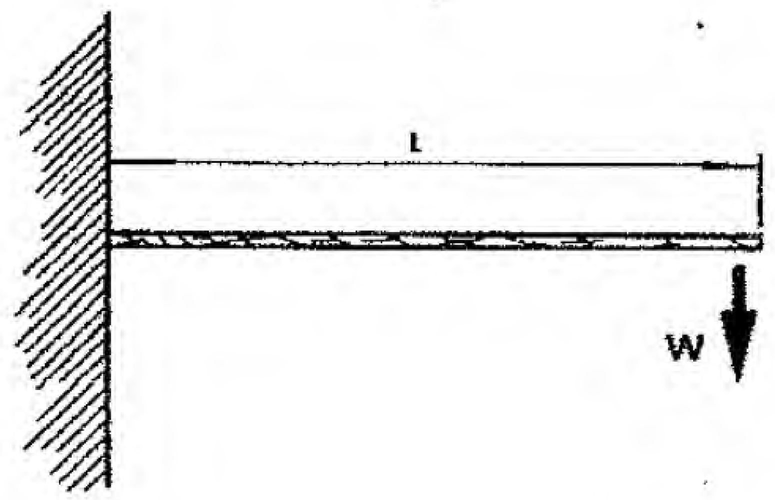
(ii) v / RUN / c / RUN / L / X / RUN / L′

(iii) v / RUN / c / RUN / M / ÷ / RUN / M′

Sample from Volume 3

BEAM BENDING

Beam with one fixed end and load W at free end



$$\text{end slope} = \frac{W\ell^2}{2EI}$$

$$\text{end deflection} = \frac{W\ell^3}{3EI}$$

Execution:

ℓ / RUN / W / RUN / E / RUN / I / RUN / slope / RUN / deflection

sto	2	00
X	·	01
X	·	02
stop	0	03
÷	G	04
stop	0	05
÷	G	06
stop	0	07
÷	G	08
#	3	09
2	2	10
÷	G	11
stop	0	12
#	3	13
1	1	14
·	A	15
5	5	16
X	·	17
rcl	5	18
=	–	19
stop	0	20
▼	A	21
goto	2	22
0	0	23
0	0	24
		25
		26
		27
		28
		29
		30
		31
		32
		33
		34
		35

RESISTORS IN PARALLEL

(capacitors in series)
(inductors in parallel)
(conductors in series)

÷	G	00
+	E	01
rcl	5	02
=	—	03
sto	2	04
÷	G	05
=	—	06
stop	0	07
▼	A	08
goto	2	09
0	0	10
0	0	11
		12
		13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
		24
		25
		26
		27
		28
		29
		30
		31
		32
		33
		34
		35

Pre-execution:

0 / ▲▼ / sto / C/CE / ▲▼ / ▲▼ / goto / 0 / 0 /

Execution:

R_1 / RUN / R_2 / RUN / $\frac{R_1 R_2}{R_1 + R_2}$ / R_3 / · · · / R_n / RUN / $R_{parallel}$

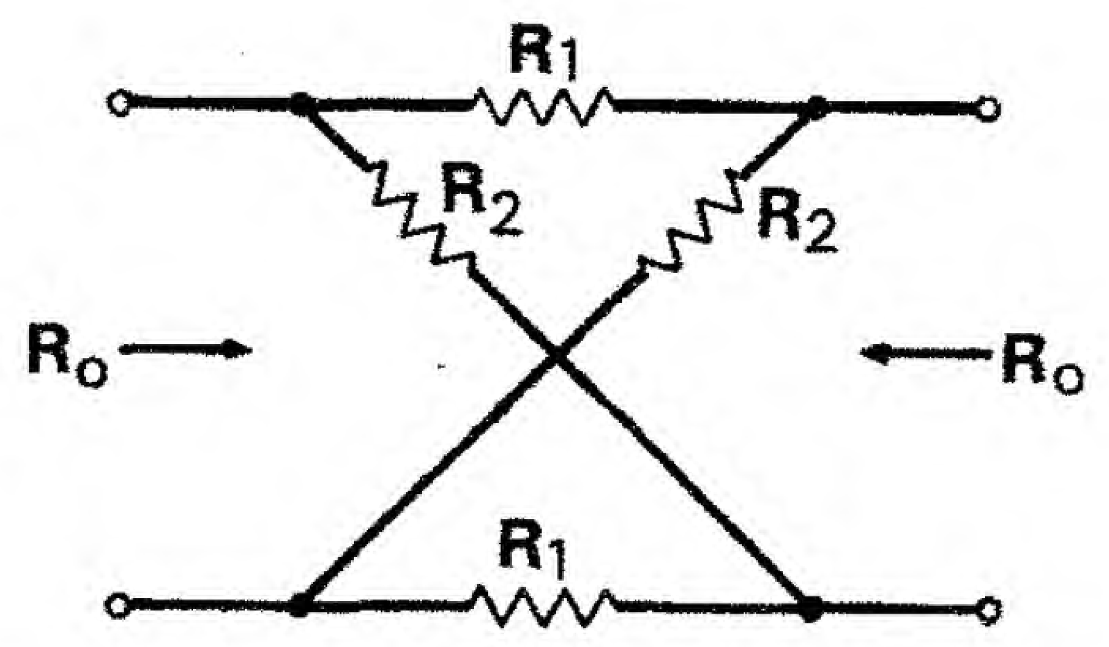
Alternative execution:

To find resistor R_2 required to make parallel combination of R_1 and R_2 = R:

R / RUN / R_1 / ▲▼ / ▲▼ / +/− / RUN / R_2

(R_1 must be greater than R)

LATTICE ATTENUATOR SECTIONS



—	F	00
÷	G	01
#	3	02
8	8	03
·	A	04
6	6	05
8	8	06
5	5	07
8	8	08
9	9	09
=	—	10
▼	A	11
e^x	4	12
+	E	13
#	3	14
1	1	15
÷	G	16
(	6	17
—	F	18
#	3	19
2	2	20
—	F	21
)	6	22
X	·	23
sto	2	24
stop	0	25
=	—	26
stop	0	27
÷	G	28
(	6	29
rcl	5	30
X	·	31
)	6	32
=	—	33
stop	0	34
=	—	35

(must be balanced, constant impedance)

$a_v = a_i = a$ $A = -20 \log a$

Characteristic impedance = R_o

$R_1 = \frac{1-a}{1+a} R_o$ $R_2 = \frac{1+a}{1-a} R_o$

Execution:

either

/ ▲▼ / ▲▼ / goto / 1 / 3 / a / RUN / R_o / RUN / R_2 / RUN / R_1

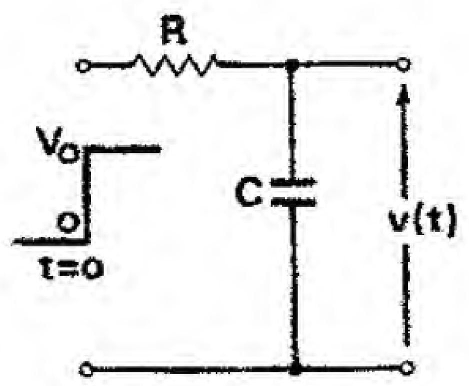
or

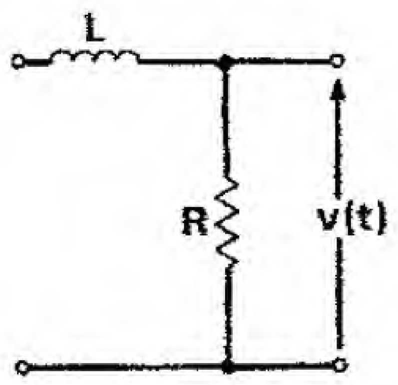
/ A / RUN / R_o / RUN / R_2 / RUN / R_1

Sample from Volume 4

LINEAR CIRCUIT THEORY

Simple L–R or C–R circuit





$\tau = CR$ or $\tau = \frac{L}{R}$

Charge: $V_c(t) = V_o(1 - e^{-\frac{t}{\tau}})$

Discharge: $V_d(t) = V_o e^{-\frac{t}{\tau}}$

Pre-execution:

R / X / C / = / ▲▼ / sto / *or*
L / ÷ / R / = / ▲▼ / sto / *or*
τ / ▲▼ / sto / ▲▼ / ▲▼ / goto / 0 / 0 /

Execution:

t / RUN / V_o / RUN / $V_d(t)$

÷	G	00
rcl	5	01
–	F	02
=	–	03
▼	A	04
e^x	4	05
X	·	06
stop	0	07
=	–	08
stop	0	09
▼	A	10
goto	2	11
0	0	12
0	0	13
		14
		15
		16
		17
		18
		19
		20
		21
		22
		23
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		33
		34
		35